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WATER RESOURCES OF BULGARIA

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Water is of great importance to the existence and the economic activities of man. Without it the life, not only of man, but of the entire organic world, is unthinkable. In modern social development, the utilization of water sites for living and economic needs has increased tremendously. On this earth, water is used for daily domestic purposes, irrigation, the production of energy, fishing, and to convey sailing vessels. The exploitation of water or the water economy is a part of the general economy of any country.

The comparatively small territory of Bulgaria with the complicated distribution of its mountains, does not favor the development of large rivers or other large water sites. On the other hand, due to the great variety in the terrain and the existing conditions of moderate climate, a relatively comprehensive network of rivers has developed. Bulgarian rivers flow toward 2 basins -- the Black Sea and the Aegean Sea basins. The main watershed which divides these 2 basins also divides the country into 2 approximately equal parts. The regions whose waters flow toward the Black Sea comprise 55% of the entire area of Bulgaria, while the regions in which the rivers flow toward the Aegean basin cover the remaining 45% of the area.

The distribution of Bulgarian river, lake, and underground waters is closely related to the physical geographic conditions. Thus, for example, the river network is the thickest in the mountain regions, where the quantity of rainfall is the greatest, and where steep mountain slopes force rain water to drain quickly. In the

plains, a large part of the rain water evaporates, or soaks into the soil and subsoil layers, and that is why there the river network is not dense. Largest river basin in that area is that of the Maritsa River -- 21,456 sq km, after which come the basins of the Struma River -- 10,795 sq km, the Iskur -- 8,602 sq km, the Yantra -- 7,892 sq km, and the Tundzha -- 7,866 sq km.

Subsoil waters supplies in Bulgaria are of second importance. They are still insufficiently explored. So far the largest reserves have been discovered in the Thracian Lowlands, the Transbalkan plains, and the Danube hill plain.

The lakes and swamps in Bulgaria are divided into 2 major groups: coastal area -- the lowlands of the Danube and the Black Sea, and high mountainous regions -- in the Rila and Pirin Mountains. The Danube shore swamps have already been entirely dried up. Only Sreburno Lake has been left, west of the town of Silistra, because of its fauna and flora which are scientifically interesting. The sea shore lakes and swamps are of larger sizes and greater economic importance. Most of them are remnants of large bays, filled with river deposits during the Quaternary Period. Largest among them is Stalin Lake, with a surface of 19 sq km and a maximum depth of 20 m.

The facts mentioned above have been given in the most general outline, to show the distribution of these 3 kinds of water sites, which are closely dependent upon diversity in the topography, while the quantity and nature of their waters is dependent upon the quality and distribution of rainfall.

The best idea of the distribution of rainfall in Bulgaria can be obtained from rain charts. If we cast a glance at the annual rainfall chart we will notice that the largest area is covered by the rainfall line showing 550 to 600 mm, per sq m, followed by the 600-650 mm line. This is due to the fact that these lines include the larger parts of the vast hilly Danube plain, the Thracian Lowlands, the low mountains, and the foothills of the high mountains. The ratio between the various rainfall lines (in area and rainfall) is easily evident in the following chart. (The chart is quoted from volume 3 of the meteorological publication of the Hydrometeorological Service.)

Quantity of rainfall	Area of rainfall strips		Average rainfall	
	In 1,000 sq km	% of the total area of the country	In million cu m	% of the total rainfall of the country
Under 500 mm	5,668	5.1	2,692,300	3.7
500 - 550	16,631	15.0	8,731,275	11.9
550 - 600	24,520	21.7	13,811,500	18.9
600 - 650	20,304	18.4	12,690,000	17.3
650 - 700	10,657	9.6	7,193,475	9.8
700 - 750	8,251	7.5	5,981,975	8.2
750 - 800	6,426	5.8	4,980,150	6.8
800 - 900	9,589	8.7	8,150,650	11.2
900 - 1000	4,798	4.4	4,558,100	6.2
over 1000	4,203	3.8	4,413,150	6.0
	110,547	100.0	73,202,575	100.0

A curve drawn on the basis of the same data very clearly shows 2 maximums in the areal and quantitative values of the individual rainfall lines. The principal maximum falls on the 550-600 mm and 600-650 mm rainfall lines, and the secondary maximum, on the 800-900 mm line. The rainfall charts also show that the rainfall lines are closely dependent on topography. Rainfalls over 650 mm are mainly found in the mountain areas and the high valleys, while in the hilly Danube plain and the Thracian Lowlands, the annual rainfall total is 400 to 600 mm per sq m. The secondary maximum undoubtedly is due to the comparatively large areas comprised in the ridged plateaus of the Rila, Rhodope and Stara Planina Mountains, over which this rainfall line stretches precisely.

The rainfall supply of the individual physical geographic regions of the country depends upon a complex of physical geographic factors, the most important of which are the altitude and the areas they comprise. The dependence of the annual volume of rainfall in the various regions on these 2 factors can be clearly seen in the following table.

It can be seen, by comparing the data shown in the table, that the annual volume of rainfall is the greatest in the Rhodope and the Stara Planina Mountains along with the Prebalkan regions, which comprise a large area, and are also rather high in altitude. The hilly Danube plain which covers a large area, has a considerably smaller volume of rainfall due to its low altitude.

The influence of physical geographic factors on the quantity of rainfall can easily be seen in the rainfall modulation, which represents the ratio between the water volume of the rainfall and the area over which rainfall occurs. It can be seen in the last

column of the table that a higher rainfall modulation is found in the Pirin and Rila Mountains, followed by the Rhodope and Stara Planina along with the Prebalkan Mountains. Thus, for example, for the Pirin Mountains the figure 28.8 shows that every second, 28.8 liters of rain fall on each sq km of area.

Regions	Average altitude in m	Area in thousands of sq km	% of total area	Rainfall in millions of cu m	% of total amount of rainfall	rainfall modulation: rain per second per sq km
Pirin	1025	1,850	1.7	1,504	2.0	28.8
Rila	1470	2,140	1.9	1,868	2.6	27.7
Rhodope	682	14,780	13.4	11,368	15.5	24.4
Thracian Lowlands	168	6,470	5.8	3,482	4.8	17.1
Stara Planina and Prebalkans	519	26,600	24.1	19,779	27.0	23.6
Hilly Danube Plain	180	25,930	23.5	14,062	19.2	17.2
Remaining part of the country	-	32,717	29.6	21,140	23.9	20.5
		110,547	100.0	73,203	100.0	21.0

Of course, rainfall modulation represents an average quantity. In reality, the amounts of rainfall during the different months and seasons of the year differ from one another and are different in the different physical geographic regions. Thus, for example, while in the hilly Danube plain and the Stara Planina Mountains along with the Prebalkan region, the maximum rainfall occurs during the summer season, while in the Thracian Lowlands and the Rhodope Mountains it occurs in spring and winter, and in the southernmost regions of the country, where the Mediterranean climatic influence is felt, in winter.

The paths followed by the rain water which has fallen on the earth's surface are varied. Part of it evaporates slowly into the atmosphere, another part is soaked up by the soil and seeps into the cracks in the rocks, a third is absorbed by vegetation, and the rest, which remains after all this, runs off in the form of river water. Because of these factors, the huge quantities of rain water which fall on the entire territory of Bulgaria, as shown above, cannot be entirely considered as its water wealth. In his economic activities, man can directly use only those amounts which flow in the form of river or subsoil waters, or collect in lakes. These are the parts of rainfall which form the Bulgarian water sites.

Since the subsoil waters move faster or slower at different places, but finally almost always emerge in the form of springs to join the rivers, and on the other hand, since most of the Bulgarian interior lakes also flow toward rivers or serve as their sources, we, by comparing the annual mass of rainfall with the annual mass of river flow, can establish the part of rainfall which is lost and is useless to man. The ratio between the water drained off for a determined period of time to the rainfall mass represents an important hydrological indicator, known as the coefficient of passage. Consequently it indicates the part of the rain, falling in a river basin, which passes into the river. In the following table, we show data concerning the coefficients of passage of the more important Bulgarian rivers.

The data given shows that the Arda and Mesta rivers, whose basins have the highest average altitude, have the highest coefficients of passage. In round figures, half of the rain mass falling in their river basins goes into river passage. Other rivers,

with smaller river basins, have smaller coefficients, since they lose most of their rain water in evaporation. As an average for the entire country, the river passage represents about one third of the rainfall mass. An overall idea of the waters of Bulgarian rivers is represented in appended chart.

Rivers	Average altitude of river basin	River basin area in sq km	Average annual rainfall mass in million cu m	Average annual flow mass in million cu m	Coefficient of passage
Maritsa, Svilengrad	569	20,721	13,593	3,875	0.29
Struma, Marno Pole	898	10,131	7,365	2,300	0.31
Iskur, Resets village	824	6,697	4,621	1,607	0.36
Yantra, Kadarovo village	440	6,446	4,576	1,205	0.26
Tundzha, Alkhovo	452	5,586	3,512	1,000	0.28
Arda, Kurdzhali	966	1,956	1,680	867	0.52
Nesta, Kremena	1,406	1,521	1,439	618	0.43
Total		53,060	86,786	11,472	0.31

The data presented so far can advance the conclusion that of the total annual rainfall mass over the territory of Bulgaria, which amounts to 73,203 billion cu m, only 1/3 is left for supplying the water sites, i.e. 24,401 billion cu m. This water mass is that which can be used for economic and living purposes.

The water work projects, which were undertaken on a large scale in Bulgaria after 9 September 1944, aim at the most rational exploitation of the Bulgarian water wealth for irrigation, production of energy, and water supply. The dams built so far, such as the

Aleksandar Stambolijev, George Dimitrov, V. Kolarov, Kalin, Studena, and Kalin, as well as those now being built, such as the smaller Pladenets and Buldzhali, cover only about 1/10 of the extant Bulgarian water resources. Another equally small part is used by the hydroelectric power plants, such as Asenitsa, Tuzha Vidima, Petrovo, Krichim, Mala Tsurkva, Pastra, and others, which have been built in the valleys of smaller rivers. The intensive construction of the Batak Power Project, and of other water power projects in the Rila, Rhodope, and Stara Planina mountains will harness the waters of the high mountain regions, which have an uncommonly high energetic value.

We have achieved a considerable success in the utilization of Bulgarian waters for purposes of irrigation. From 600,000 decares irrigated in 1943, the amount of irrigated area had increased to 3,600,000 decares in 1955. Dozens of small new dams are being built, by means of which the irrigated areas are being constantly expanded.

The development of water work projects is helping in the speedy transformation of the face of Bulgaria. Beautiful new lakes have appeared in Bulgarian valleys. The network of irrigation canals, which are changing the droughty plains of the past into flowery gardens, is growing. However, we have so far encompassed only one small part of the Bulgarian water resources. The Bulgarian water projects are aiming at a wide field of activity through which a great contribution will be made to the creative transformation of the Bulgarian natural resources and to the improvement of the welfare of the Bulgarian people.

FIGURE CAPTIONS

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Chart on the water quantity in Bulgarian rivers.

Legend: water quantities 10 m³/sec, 30 m³/sec, 50 m³/sec,
100 m³/sec.

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View of the Kopotamo River

The Maritsa River

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The Stalin Dam

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One of the Sedemte Rila Lakes